ADLINK
Leading EDGE COMPUTING

Solution Brief

Increasing Mobile Robot Intelligence to Advance Human-Machine Collaboration

ADLINK Mini-ITX embedded motherboards and Robot Operating Systems (ROSs) help robots assess and react to their environments.



www.adlinktech.com

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Robot Mobility

Robots play important roles in the automation of processes across a wide range of industries, such as smart manufacturing and logistics, where they assemble and transport inventory, among many other tasks.

Some tasks require robots to move around a factory floor or warehouse, and these robots generally fall into two categories: automated guided vehicles (AGVs) and autonomous mobile robots (AMRs). The first AGVs were deployed in the 1950s, and they followed a wire in the floor. Today's AGVs/AMRs can detect markers using vision, lasers, and magnets for navigation1 but still their routes are limited to fixed patterns laid down in a facility. Mobile robots following a static route generally have relatively low computational requirements.

Advances in vision technology, artificial intelligence (AI), and communications and computing technologies have led to a new generation of mobile robots. Like self-driving cars, next-generation AGV/AMRs utilize trackless navigation1, plan the best routes, complete missions without boundaries, and avoid collisions – all without the need for external guidance. As a result, future AGVs/AMRs will require large amounts of computing and graphic processing performance, delivered by a low power, small form-factor board. This intelligence also provides new opportunities for humans and machines to collaborate, such as working alongside one another to fill customer orders in a warehouse.

Future AGVs/AMRs will have the flexibility to adjust to changes in a facility's floorplan or processes through a straightforward software update that allows them to navigate properly and carry out new tasks. Operations teams will be able to reconfigure them to adapt to evolving business needs with much less effort than prior generation AGVs/AMRs that rely on inflexible tracks. Future mobile robots will be controlled by fleet software that assigns tasks to robots based on their availability and location, thus increasing their efficiency, productivity, and ability to work collaboratively with other robots and humans.

ADLINK provides different application specifications of Mini-ITX form factor boards to satisfy application requirements of today's and future AGV/AMR designs.

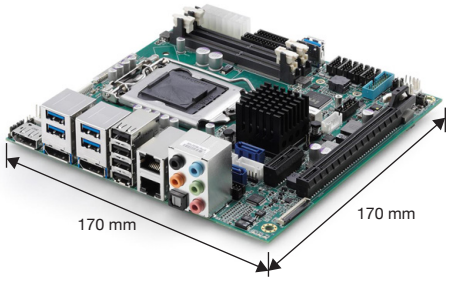


Figure 1. Example of Autonomous Mobile Robot (AMR) and Automated Guided Vehicles (AGVs) Works in the Smart Factory

Mini-ITX Small, Versatile Form-Factor

The saying "less is more" sums up why many robot designers are using Mini-ITX embedded motherboards in AGVs and AMRs. Measuring 170 mm (6.75 inches) per side, Mini-ITX is just 38% the size of the mainstream ATX boards, which makes it one of the smallest PC form factors. Robot developers are taking advantage of boards with more expandability, graphics, and CPU options to meet the needs of various types of mobile robots.

ADLINK achieves this high density by focusing on thermal management and the careful selection and placement of board components. Models of airflow and cooling solutions (heatsinks and fans) ensure the temperatures of all board components are maintained within functional limits. Thermal design and cooling solutions are particularly important in AGV/AMR designs given their stringent space and operating temperature constraints.



A Useful Tool - Robot Operating System 2.0 (ROS 2.0)

The ADLINK AmITX-SL-G Mini-ITX embedded motherboard supports the Robot Operating System 2.0 (ROS 2.0), middleware software that provides a common framework for robotics. Within ROS/ROS2.0, there are numerous open-source software packages for adding intelligence to applications, including 2D/3D point cloud processing, robot motion planning and navigation, off-line visualization, and planning tools[2]. ROS 2.0 also uses Data Distribution Service (DDS) as the communication middleware to provide a distributed/asynchronous data exchange mechanism with high quality of service (QoS) to ensure transmission quality and stability, enabling it to be the main data transmission standard for the network in a facility.

ADLINK Mini-ITX Boards for Mobile Robotics

Robotic system developers can choose between two scalable ADLINK Mini-ITX boards (Table 1) that feature a mix of powerful x86 processors, a rich set of I/O interfaces, and PCIe slots to add a graphics processing unit (GPU) to run AI applications. The AmITX-SL-G, with high-end processors and DDR4 memory, is designed for complex operations, and the AmITX-AL-I is suitable for lighter operations.

1. "Automated Guided Vehicle," from Wikipedia, https://en.wikipedia.org/wiki/Automated_guided_vehicle

2. "ROS Industrial Annual Meeting 2018," https://rosindustrial.squarespace.com/s/257897_ROS-AM-Program-forWEB-43ls.pdf

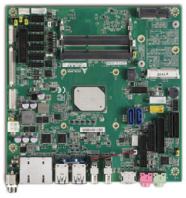
Mobile Robot Systems	Lighter Operations	More Complex Operations
Product Name	AmITX-AL-I	AmITX-SL-G
Product Image		
Processor Support	Intel® Atom® E3900 Series SoC, Intel Pentium® Processor, and Intel Celeron® Processor	6th/7th Generation Intel® Core™ i7/i5/i3 Processors, Intel Pentium® and Intel Celeron® Processors
Memory	Up to 16GB non-ECC DDR3L memory at 1866/1600 MHz	Up to 32GB dual channel DDR4 at 2133/2400 MHz
Graphics	Intel® Gen9 low power graphics	
High-Speed I/O	PCIe x1 and Mini PCIe (full size) with USB	PCIe x16, PCIe x1, and Mini PCIe expansion
Other I/O Interfaces	USB, Serial ATA, KB/MS, serial ports, and digital I/O	
Management Application	Smart Embedded Management Agent (SEMA®)	

Table 1. Features of two families of ADLINK Mini-ITX Embedded Boards

ADLINK ROS Starter Kit – Neuron[3]

During the development phase, robotic system developers can code applications using the ADLINK Neuron platform, which can be configured with a high-end CPU and GPU. If less computing and graphics performance will be sufficient, developers can simply substitute a less costly, mid-range CPU or GPU on the platform while maintaining a consistent software environment. Neuron also has a wide range of I/O ports for sensor connection. Moreover, Neuron is compatible with ROS 2.0, allowing it to control the robot through the ROS application library with a wide range of open source software (e.g., camera, navigation, and motion control), thereby reducing development

CPU	6th/7th Generation Intel® Core™ i7/i5/i3 Processors, Intel Pentium® processor, and Intel Celeron® Processor
Memory	Up to 32GB dual channel DDR4 at 2133/2400 MHz
Storage	SATA 6 Gbps ports x3
Graphics	Intel® Gen9 low power graphics
High-Speed I/O	PCIe x16, PCIe x1, and Mini PCIe expansion
Other I/O Interfaces	USB, Serial ATA, KB/MS, serial ports, and digital I/O
Management Application	Smart Embedded Management Agent (SEMA®)
Software	Support ADLINK DDS Middleware Support ROS/ROS2 (Robot Operating System)

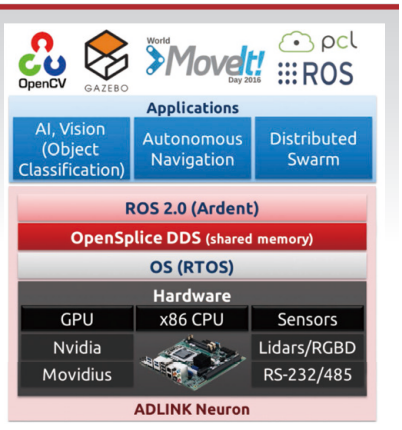


Table 2. Specifications of ADLINK ROS Starter Kit - Neuron

Productivity Gains from AGV/AMRs

The primary task of mobile robots is to transport materials throughout a facility, which is made easier by the next-generation AGVs/AMRs that can navigate on their own without tracks. Operation teams can reconfigure their mission, and even change their task on the fly using ROS 2.0. These capabilities enable AGVs/AMRs to be more productive than their predecessors.

Future AGVs/AMRs require a significant amount of computing and graphics power in a small space, capabilities ADLINK Mini-ITX boards are designed to deliver. In addition, developers can complete complex designs in less time by using the ADLINK Neuron platform to help choose the right CPU and GPU combination as well as take advantage of the software and communication standards established by ROS 2.0.

3. ADLINK Neuron Website: https://neuron.adlinktech.com/en/

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